CLAIMS

1 - A bidirectional actuator comprising at least a stator structure excited by an electric coil, and a magnet which is movable in a primary air gap, characterized in that the stator structure is composed of two pairs of stator poles (1 to 4), each of the pair of poles being wound by at least one electric coil, the stator structure defining at least a first secondary air gap (6, 8) for displacement of the single movable magnet (14) relative to a first degree of freedom, and a second secondary air gap (7, 9) for displacement of the single movable magnet (14) relative to a second degree of freedom.

2 - A bidirectional actuator according to claim 1, characterized in that the movable magnet is integral with the yoke.

3 - A bidirectional actuator according to claim 1 or 2, characterized in that the stator structure is composed of 4 poles of soft magnetic material, which define therebetween two pairs of secondary air gaps which cross at a central point and in that the primary air gap (10) is planar.

4 - A bidirectional actuator according to claim 3, characterized in that the stator poles comprise 4 rectangular pieces, each wound by an electric coil, and defining between them two pairs of perpendicular secondary air gaps.

5 - A bidirectional actuator according to at least one of the preceding claims, characterized in that the ratio L/E of the thickness L of the magnet and the thickness E of the air gap ranges between 1 and 2.

6 - A bidirectional actuator according to at least one of the preceding claims, characterized in that the dimensions of the secondary air gaps are $C_1 + E$ and $C_2 + E$, where C_1 and C_2 denote the

travel range of the movable magnet in the two directions of the secondary air gaps and in that the dimensions of the magnet are $C_1 + d_1 + E$ and $C_2 + d_2 + E$, where d_1 and d_2 denote the widths of the secondary air gaps.

7 - A bidirectional actuator according to claim 1 or 2, characterized in that the stator structure is composed of two stator pieces disposed one on one side and one on the other of the magnet, each stator piece having a pair of stator poles, the pair of stator poles of one of the pieces being oriented perpendicular to the pair of stator poles of the other stator piece.

8 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to a stator structure formed from 4 stator poles in the form of cylinder portions, provided with a first secondary air gap in the longitudinal central plane, in which there is placed a first electric coil wound around at least one ferromagnetic core, and with a second secondary air gap in the transverse plane, in which there is placed a second electric coil wound around a ferromagnetic core.

9 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to an external cylindrical stator structure formed from 4 stator poles having a concave surface defining the primary air gap with the cylindrical yoke placed inside the magnet, each of the four stator poles being wound by an electric coil.

10 - A bidirectional actuator according to claim 1 or 2,

characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to a cylindrical stator structure comprising a first external stator piece for displacement in a first degree of freedom and a second internal stator piece for displacement in a second degree of freedom, each of the stator pieces having at least one electric exciting coil.

11 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is movable in spherical rotation relative to a stator structure in the form of a spherical cup formed from 4 stator poles in the form of cup sectors provided with two coils located in peripheral grooves whose central planes are perpendicular.

12 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is movable in spherical rotation relative to a stator structure of tubular shape formed from 4 stator poles in the form of tube quarters, wound by an electric coil.

13 - A bidirectional actuator according to claim 11, characterized in that the primary air gap has spherical shape.

14 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is enclosed by a spherical cup, and is movable in spherical rotation around a stator structure of spherical or hemispherical shape formed from 4 stator poles in the form of sphere quarters or eighths.

15 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is enclosed by a cup formed from two pieces in the form of hemispheres

or sphere quarters, and is movable in spherical rotation around a stator structure formed from two hemispherical stator pieces.